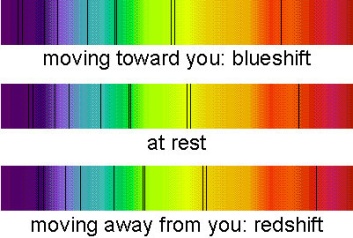
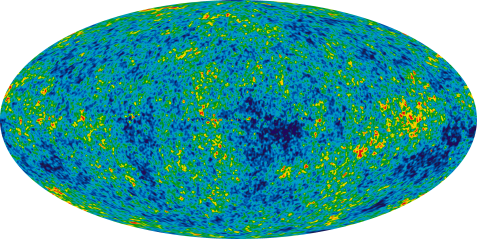
**BIG BANG**

**The Big Bang Model is supported by a number of important observations:**

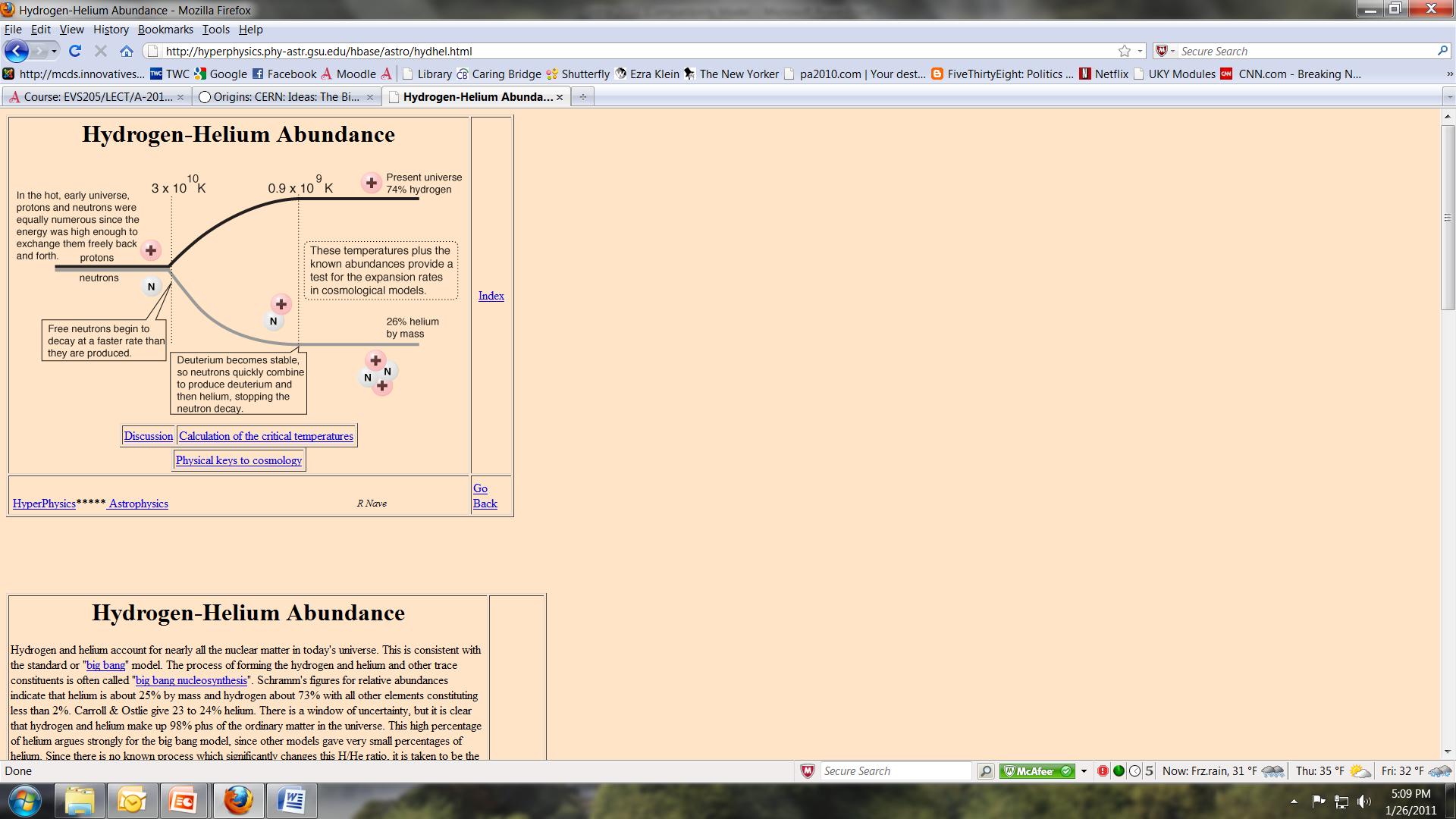
[The expansion of the universe](http://map.gsfc.nasa.gov/universe/bb_tests_exp.html) Edwin Hubble's1929 observation that galaxies were generally receding from us provided the first clue that the Big Bang theory might be right. The evidence lies in the **Cosmological Redshift**: a redshift caused by the expansion of space. The wavelength of light increases as it traverses the expanding universe between its point of emission and its point of detection by the same amount that space has expanded during the crossing time.



[The cosmic microwave background (CMB) radiation](http://map.gsfc.nasa.gov/universe/bb_tests_cmb.html) The early universe should have been very hot. The cosmic microwave background radiation is the remnant heat leftover from the Big Bang. The wavelength of the light has stretched into the microwave part of the electromagnetic spectrum, and the CMB has cooled to its present-day temperature, 2.73 degrees above absolute zero.



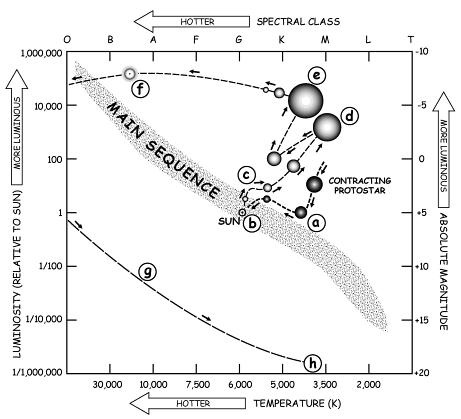
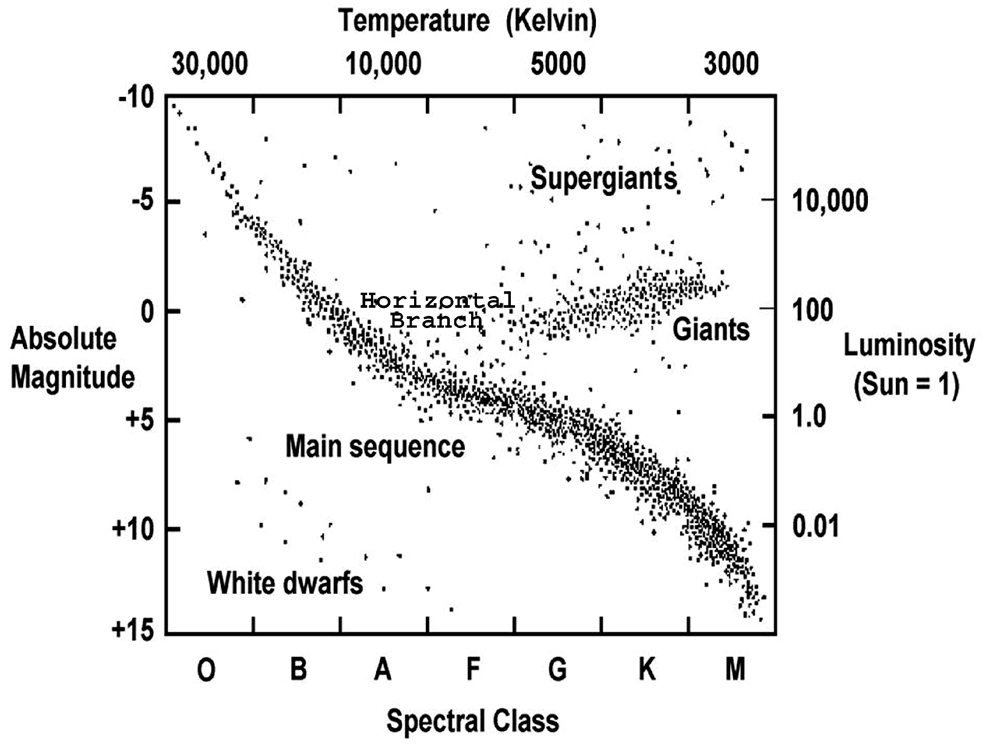
[The abundance of the light elements H, He](http://map.gsfc.nasa.gov/universe/bb_tests_ele.html) The Big Bang theory predicts that these light elements should have been fused from protons and neutrons in the first few minutes after the Big Bang.



***These three measurable signatures strongly support the notion that the universe evolved from a dense, nearly featureless hot gas, just as the Big Bang model predicts.*** According to the standard theory, our universe sprang into existence as "singularity" around 13.7 billion years ago. Singularities are zones which defy our current understanding of physics. They are thought to exist at the core of "black holes." Black holes are areas of intense gravitational pressure. The pressure is thought to be so intense that finite matter is actually squished into infinite density (a mathematical concept which truly boggles the mind). These zones of infinite density are called "singularities." After its initial appearance, it apparently inflated (the "Big Bang"), expanded and cooled, going from very, very small and very, very hot, to the size and temperature of our current universe.

**STELLAR EVOLUTION/NUCLEOSYNTHESIS SUMMARY:**

Stars spend most of their life on the main sequence of the H-R diagram:



The majority of stars, including our Sun, are found along a region called the Main Sequence. Main Sequence stars vary widely in temperature but the hotter they are, the more luminous they are, therefore the main sequence tends to follow a band going from the bottom right of the diagram to the top left. These stars are fusing hydrogen to helium in their cores. Stars spend the bulk of their existence as main sequence stars. The next part of their evolution depends on their mass. Our sun will become a red giant before it eventually settles into a white dwarf.

1. Protostar, gravitational contraction of cloud of gas and dust.
2. Stable main sequence star, shining by nuclear fusion (converting hydrogen to helium.
3. Evolution to red giant when helium core forms.
4. Red giant shining by helium fusion.
5. Variable star formation of carbon core.
6. Planetary nebula enriched hydrogen envelope ejected into space.
7. White dwarf, mass packed into star about the size of earth.
8. Dead black dwarf in space.

Larger stars have more fuel but they burn it faster to maintain equilibrium. Because fusion occurs at a faster rate in massive stars, they use all of their fuel in a shorter length of time. Therefore, large stars have shorter lives than small stars.

The elements observed in the Universe were created in either of two ways.

- **Light elements** (namely deuterium, helium, and lithium) were produced in the first few minutes of the Big Bang.

- **Elements heavier than helium** were born in the hot interiors of stars which formed later in the history of the Universe.

Most of the elements that make up your body and our earth were created in very large stars and/or supernovae! (These were not created in OUR sun, our solar system and planets are the result of an ancient star (obviously older than the age of earth ~4.6 BY) that exploded into a supernova.”

**Age of Earth Summary**

To determine the age of earth, we don’t look at the earth itself as the rock cycle has re-contoured the surface more often than a reluctantly aging Hollywood star. No, we look at the radiometric dates of gracefully aging materials that formed at the same time (meteorites).

The oldest known materials found on earth are the Jack Hills zircon crystals from Western Australia that are 4.4 billion years old! These crystals are more tenacious than opossums.

A half-life is the time required for half of the parent isotope to decay to its daughter. After two half lives 25% parent, 75% daughter remains, after three half lives 12.5% parent, 87.5 daughter remains. To determine how many atoms of parent isotope were there at time zero (when crystallization occurred) you just add together the number of parent and daughter atoms.

**Active Sun Summary**

Sunspot cycle (11 years) results from magnetic pole reversals and more sunspots = more activity

Solar flares

* Reach the Earth in minutes
* Huge bursts of radiation

Coronal Mass Ejections (aka a middle school science teacher’s worst nightmare of a topic with pubescent boys)

* Reach the earth in 1-3 days
* Huge ejection of particles (interacting with our magnetosphere results in aurora borealis)
* Only affect the earth when released in the direction of earth

Our magnetosphere protects the earth from harsh effect of solar weather – deflecting the constant bombardment of solar weather. Planets such as Mars which do not have a strong magnetosphere long ago had their atmospheres wiped away by solar weather and today have their surfaces constantly bombarded by solar storms. “May the force be with you” isn’t a phrase we expect to hear from Martian sci-fi writers.